Berkeley Lab Test Facility for Low-Energy Integrated Building Systems

HVAC Study Support

May 2011

HVAC Study Support:

Research Objective/Outcomes

- Comparison testing: Side-by-side testing of base case (i.e., typical standard compliance or existing systems) and alternative technologies under identical building conditions.
- Ability to characterize differences in performance of existing (and new) products.
- Product development: provide environment to study, improve, and develop methods and devices relating to space conditioning.
- Demonstrations: Demonstrate new and existing products/technologies and variations thereof.
- Performance validation of 'integrated systems' as opposed to component efficiency performance
- System optimization and validation: Validate whole system performance vs. simulation; optimize operational and design parameters.
- Model validation; validate energy models developed through testing
- Fundamental integrated systems research: testing to determine impact on performance of various space design and operating factors; e.g.,
    - "load characterization" to determine the impact on stratification of type, strength, combinations and locations of internal loads.
    - Impact of blinds/shading devices/external conditions on thermal performance of various technologies
    - Impact of types and locations of interior furnishings and layouts

HVAC System Support

The test beds will include the infrastructure to support all major types of 'end use' HVAC devices needed for the specific systems being tested. The test beds are designed for quick reconfiguration to allow for cost effective experimental setups. All systems will be possible to configure separately or in any combination.
Systems supported will include but are not limited to:

- VAV boxes
- Variable speed fan coil units
- Hot water baseboards
- Modulating dampers
- Diffusers
- Under-floor and overhead ducting
- Full scale testing of UFAD
- Radiant heating and cooling systems, (panel and in-slab)
- Chilled beam.

Envelope System Support

- Exterior wall constructions will support a variety of types, thicknesses, glazing arrangements (window wall ratio & placement) as well as interior and exterior shading systems. Specific south facing envelope configurations can be made to suite specific experimental needs.
- Side and rear walls will be highly insulated and uniform construction.
- Ceiling/Roof and sub-floor will be temperature-controlled surfaces to simulate a variety of adjacent floor conditions.
- Ceilings will support hung, cloud, and open configurations (including radiant panels)
- Floors will support raised access floors, radiant slabs, and passive slabs (or simulators thereof) including options for commonly employed surface treatments

Lighting System Support

Infrastructure will be put in place to support overhead and task lighting systems. System will be designed for quick and efficient reconfiguration.

Instrumentation

Instrumentation will consist of an integrated control and data acquisition system with easily programmable controls capabilities and for comprehensive but flexible data presentation and remote access. Instrumentation should include:

- Surface temperatures: All inside surface temperatures.
    - Raised floors, hung ceiling both sides with granularity of ~4 ft. Roof and sub-floor inside surface with ~4 ft granularity.
    - Surface sensors embedded into surface.
    - Window surface temperatures via shielded surface sensors or IR sensors; both sides. Calibrated accuracy =+- 0.1 °C.
    - Stratification trees: 12-16 points with fast response sensors (thermocouples or thermistors) Calibrated accuracy = +- 0.1 °C

- Other temperatures: all with All Calibrated accuracy +-0.2°C
    - Mean radiant
    - Under-floor plenum
    - Return plenum
    - Sensors in all diffusers
    - Room supply and return duct sensors (averaging);
    - Hot and chilled water entering and leaving terminal devises.
- Solar sensors:
    - Pyranometers
    - Thermopiles

- Power monitoring:
    - All internal loads
    - overhead lighting
    - task lighting,
    - fan powered terminal units
    - computers
    - simulated people,
    - control and DAQ power if within the cell. Accuracy = 1% of full scale.

- Air and water flow: Accuracy 1% of reading.
- Pressure: Accuracy = 0.25% full scale or better.
    - Room
    - supply plenum

Flow visualization: Smoke or bubble generators (and associated light sources) or PIV system.